MOISTURE CONTENT OF BITUMINOUS MIXES BY OVEN FOP FOR WAQTC TM 6

Significance

01 Even though aggregate used in bituminous mixes is
02 heated and dried at high temperatures, some types of rock retain moisture. The moisture content of the mix must be known in order to correctly determine the asphalt cement binder content of the mix. Moisture (water) in the mix will yield erroneously high binder content values whether binder content is determined by the nuclear content gauge or ignition furnace method.

Scope

This procedure covers the determination of moisture content of bituminous mixes in accordance with WAQTC TM 6.

Background on Test Method

03 A test sample of bituminous mix is dried in an oven. The moisture content is calculated by one of two methods depending upon agency standards.

- When binder content is reported as a percent of the initial mass of bituminous mix, moisture content is reported as a percent of the initial, moist mass of mix.
- When binder content is reported as a percent of the mass of aggregate, moisture content is reported as a percent of the final, dry mass of mix.

04 **Oven**

Apparatus

- Balance or scale: 2 kg capacity, readable to 0.1 g conforming to AASHTO M 231
- Forced Draft, Ventilated, or Convection Oven: Capable of maintaining the temperature surrounding the sample at 163 ±14°C (325 ±25°F)

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Quartering

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Mass determination

- Sample Container: Clean, dry, not affected by heat and of sufficient size to contain a test sample without danger of spilling
- Thermometer with a temperature range of 10-260°C (50-500°F)

Sample

The test sample shall be obtained in accordance with AASHTO T 168, and reduced in accordance with WAQTC TM 5. The size of the test sample shall be a minimum of 1000 g.

Procedure

1. Set the oven to a minimum of 105°C (221°F). In no case should the Job Mix Formula (JMF) mixing temperature be exceeded.
2. Determine and record the mass of the sample container to the nearest 0.1 g.
3. Place the test sample in the sample container, and record the temperature of the test sample.
4. Remove the thermometer from the sample. Determine and record the total mass of the sample container and test sample to the nearest 0.1 g.
5. Calculate the initial, moist mass (M_i) of the test sample by subtracting the mass of the sample container determined in Step 2 from total mass of the sample container and the test sample determined in Step 4.
6. Dry the test sample to a constant mass in the sample container.

   Note 1: Constant mass shall be defined as the mass at which further drying does not alter the mass by more than 0.05 percent. The sample shall be initially dried 90 minutes, and its mass determined at that time and at 30 minute intervals after that until a constant mass is reached.
7. Cool the sample container and test sample to approximately the same temperature as determined in Step 3.
8. Determine and record the total mass of the sample container and test sample to the nearest 0.1 g.

Note 2: Do not attempt to remove the test sample from the sample container for the purposes of determining mass.

9. Calculate the final, dry mass (M_f) of the test sample by subtracting the mass of the sample container determined in Step 2 from the total mass of the sample container and the test sample determined in Step 8.

Note 3: Moisture content and the number of samples in the oven will affect the rate of drying at any given time. Placing wet samples in the oven with nearly dry samples could affect the drying process.

Calculations

Constant Mass:

Calculate constant mass using the following formula: 09

$$\%Change = \frac{M_p - M_n}{M_p} \times 100$$

Where: M_p = previous mass measurement
M_n = new mass measurement

Example:
Mass of container: 232.6 g 10

Mass of container after first drying cycle: 1361.8 g

Mass, M_p, of possibly dry sample: 1361.8 g – 232.6 g = 1129.2 g

Mass of container and dry sample after second drying cycle: 1360.4 g
Mass, M_n, of dry sample: 1360.4 g – 232.6 g = 1127.8 g

$$0.12\% = \frac{1129.2 - 1127.8}{1129.2} \times 100$$

0.12% is not less than 0.05% so continue to dry it

Mass of container and dry sample after third drying cycle: 1359.9 g
Mass, Mn, of dry sample: 1359.9g – 232.6g = 1127.3g 11

$$0.04\% = \frac{1127.8 - 1127.3}{1127.8} \times 100$$

0.04% is less than 0.05% so it is dry
This mass becomes the Dry mass (M_f) for calculating the moisture content.

Moisture Content:

Calculate the moisture content, as a percent, using one of the following two formulas.

Percent of Initial, Moist Mass:

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$$\text{Moisture Content} = \frac{M_i - M_f}{M_i} \times 100$$

where M_i = initial, moist mass
M_f = final, dry mass

Example:

M_i = 1134.9 g
M_f = 1127.3 g

$$\text{Moisture Content} = \frac{1134.9\,\text{g} - 1127.3\,\text{g}}{1134.9\,\text{g}} \times 100 = 0.670, \textit{ say } 0.67\%$$

Percent of Final, Dry Mass:

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$$\text{Moisture Content} = \frac{M_i - M_f}{M_f} \times 100$$

where M_i = initial, moist mass
M_f = final, dry mass

Example:

M_i = 1134.9 g
M_f = 1127.3 g

$$\text{Moisture Content} = \frac{1134.9\,\text{g} - 1127.3\,\text{g}}{1127.3\,\text{g}} \times 100 = 0.674, \textit{ say } 0.67\%$$

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Report

Results shall be reported on standard forms approved for use by the agency. Report the moisture content to 0.01 percent.

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Tips!

- Remember: Moisture content is expressed as a percent of initial, moist mass when binder content is reported as a percent of mix mass.
- Remember: Moisture content is expressed as a percent of final, dry mass when binder content is reported as a percent of aggregate mass.

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